NsG-6-59



# INTERNAL FRICTION PEAKS IN SILVER AND PLATINUM AT LOW TEMPERATURES[1]

2p.

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(Received 7 March 1963)

N63 17338
Code None

The considerable amount of work which has been done on the Bordoni and Niblett-Wilks internal friction peaks observed at low temperature in cold-worked fcc metals was recently reviewed by Niblett and Wilks.[3] Of the several theories[4-6] advanced to assist in interpretation of the experimental facts concerning these peaks, to date, the kink-pair formation mechanism developed by Seeger[4] seems to explain best the accumulated data.[7]

In connection with a study of the effect of low temperature annealing on these low temperature internal friction peaks,[7] the location of the Bordoni peaks in polycrystalline silver (99.999%) and platinum (99.999%) wires, prestrained in torsion, was determined at a measuring frequency of about 1 cps. These results along with those due to Bordoni and others,[8] determined at high frequency, allow the determination of the activation energy and attempt frequency associated with the Bordoni peak in these materials over a frequency range covering about 6 orders of magnitude.

The activation energy ($E$) and attempt frequency ($\nu_0$) determined from the data shown in Fig. 1 were 0.098 eV and $6 \times 10^{11}$ $\sec^{-1}$ for Ag and 0.29 eV and $5 \times 10^{12}$ $\sec^{-1}$ for Pt, respectively. Figure 2 shows that the Bordoni peak in Ag after room-temperature annealing apparently consists of two peaks, one at 35°K and another at 50°K at about 0.8 cps. The high frequency measurements do not resolve two peaks; consequently, for comparison the average temperature for the two peaks has been taken in the plot shown in Fig. 1. The temperature of the Bordoni peak in Pt moved to higher temperature after annealing above room temperature as shown in Fig. 3. Since the data reported by Bordoni and others[8] have been obtained for specimens cold worked at room temperature, for proper comparison the results from room-temperature annealing during the present study are employed. The details of the annealing behavior of the peaks are discussed elsewhere.[7]

From the calculations of Donth[9] and Seeger and others[4] it is possible to evaluate the Peierls stress, $\tau_P^0$, from the average activation energy determined above. In line with the reasoning of Paré,[10] an internal stress of magnitude 0.10 $\tau_P^0$ is assumed to exist. Such calculations yielded $\tau_P^0/G \approx 5.1 \times 10^{-4}$

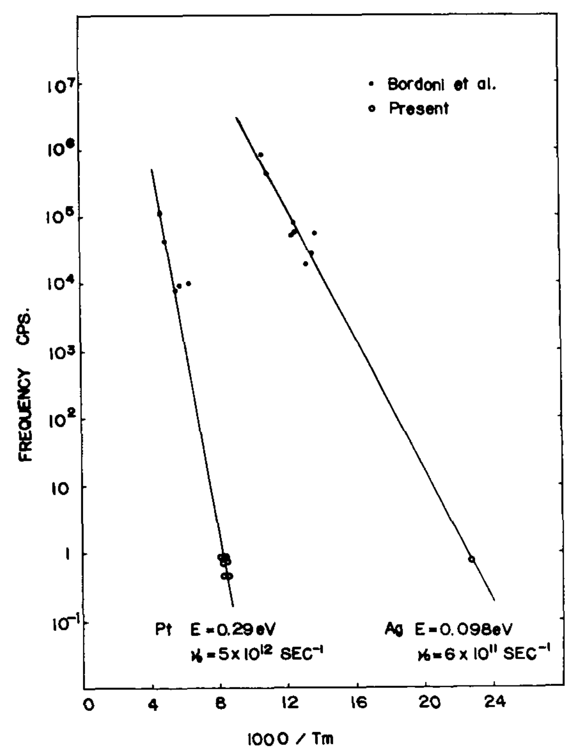


**Fig. 1. Log frequency vs reciprocal temperature of the Bordoni peak in silver and platinum.**

INDEXING CATEGORIES

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|---|---|
| A. Ag and Pt | D. low temperatures |
| A. internal friction peaks | E |
| B. activation energy | |
| B. attempt frequency | |
| C. annealing | |



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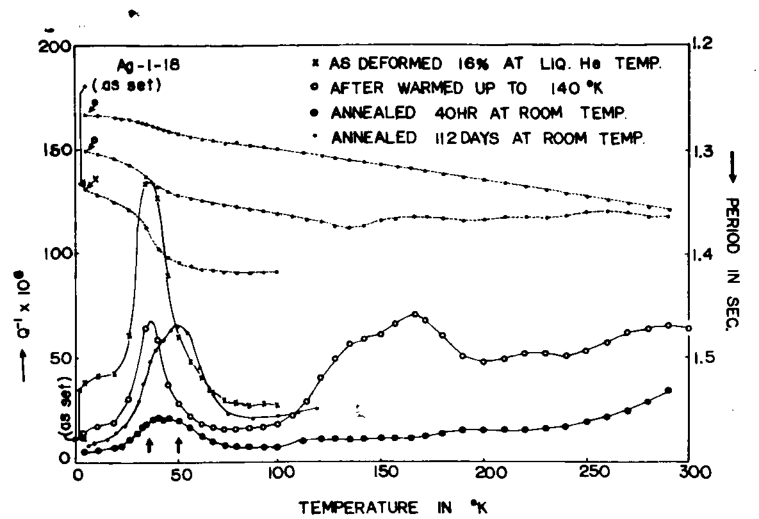


**Fig. 2. Internal friction (solid line) and dynamic modulus (dashed line) of silver specimen twisted 16% (maximum shear strain) at 4.2°K.**

for Ag and $\tau_P^0/G \approx 9.8 \times 10^{-4}$ for Pt. $G$ is the shear modulus for Ag and Pt.

It should be noted in Fig. 2 that the dynamic modulus in Ag begins to rise with increasing temperature above about 140°K when the specimen was warmed above this temperature for the first time. This suggests that the dislocation lines are becoming pinned by point defects above 140°K. Also, at about the same temperature the internal friction exhibits a pronounced increase. Similar behavior was observed at about 180°K in Pt but the data are not presented here. These observations are similar to those made on the internal friction peaks in gold and copper,[11] and which are believed to be associated with a dislocation-point defect interaction. The present results suggest that these peaks may be common not only to Au and Cu but also to Ag and Pt. Further studies are planned on this subject.

The author wishes to thank J. M. Roberts of the Mechanical Engineering Department of Rice University for numerous valuable discussions. Assistance with the experiments by numerous other members of the Mechanical Engineering Department and some members of the Physics Department at Rice University is gratefully acknowledged.

[1] This work was supported by the National Aeronautics and Space Administration under Grant NsG-6-59.

[2] On leave (1960-1962) from the Institute of Physical and Chemical Research, Tokyo, Japan.

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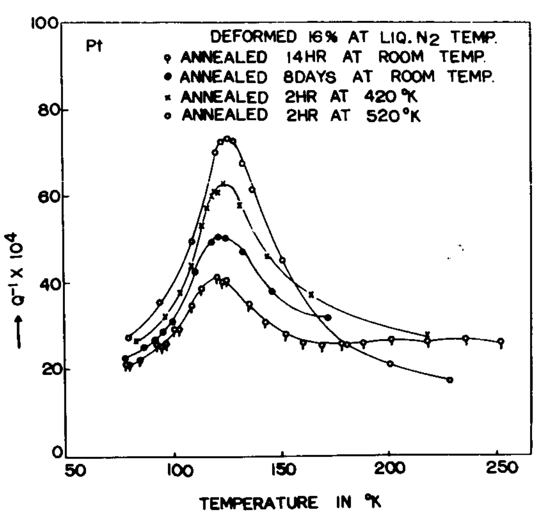


**Fig. 3. The Bordoni peak in a platinum specimen.**